CLAIMS

1. Method of coating a substrate surface comprising the steps of:
-preparing one powder mixture, or several powder mixtures having different chemical composition, wherein at least one of said powder mixtures comprise a non-hydrated hydraulic ceramic powder binder phase,

-pre-treating the surface of a substrate to increase the adhesion between the substrate and the ceramic coating,

-applying one or more layers of said non-hydrated powder mixtures on top of each other on the substrate, and

-hydrating the powder layer/layers utilizing a curing agent comprising ions of carbonates, phosphates or fluorides.

2. Method of coating a substrate surface according to claim 1, **characterised in that** the step of preparing a powder mixture further comprises adding particles or powder of one or more biocompatible materials composed of particles or powder of one or several phases containing phosphates, flouorides or carbonates, calcium carbonate, calcium phosphate, apatite, fluoroapatite, carbonates-apatites, hydroxyapatite and phosphorous glasses of good biocompatibility.

3. Method of coating a substrate surface according to claim 1, **characterised in that** it further comprises the step of adding a non-hydraulic filler comprising calcium titanate or any other ternary oxide of perovskite structure according to the formula ABO_3, where O is oxygen and A and B are metals, or any mixture of such ternary oxides, said filler being present in an amount of less than 30 vol.%, preferably less than 10 vol.% of the total volume of the ceramic ingredients.

4. Method of coating a substrate surface according to claim 1, **characterised in that** the step of preparing a powder mixture includes reducing the powder grain size, preferably such that it is below 10 μm and more preferably between 0.1 and 3 μm.

5. Method of coating a substrate surface according to claim 1, **characterised in that** the pretreatment of the substrate is performed by blasting its surface with hard particles.

6. Method of coating a substrate surface according to claim 1, **characterised by** the step of embedding fragments or powder of a hydraulic ceramic, preferably of calcium aluminate in the substrate surface.

7. Method of coating a substrate surface according to claim 6, **characterised in that** the embedding is performed by blasting the substrate surface with fragments or powder of a hydraulic ceramic, preferably with calcium aluminate.

8. Method of coating a substrate surface according to claim 1, **characterised in that** a pretreatment of the substrate surface to a surface roughness in the range of R_a 0.1 to 10.0 μm is performed before deposition of the powder mix.

9. Method of coating a substrate surface according to claim 1, **characterised by** the step of pre-treating the substrate surface with an accelerator-agent for accelerating the hardening process.

10. Method of coating a substrate surface according to claim 1, **characterised in that** the powder layer is applied by a thermal spray technique, PVD or CVD deposition techniques, or applied as a tape

prepared by tape casting.

11. Method of coating a substrate surface according to claim 1, **characterised in that** the applied non-hydrated ceramic powder layer/layers are compacted prior to the final hydration.

12. Method of coating a substrate surface according to claim 11, **characterised in that** the compacting is achieved by using cold isostatic pressing (CIP), hot isostatic pressing (HIP), or by passing a laser beam across the surface.

13. Method of coating a substrate surface according to claim 12, **characterised in that** the degree of compaction of the powder layer is increased between 30 and 80 % and the porosity reduced to 30-45 vol%.

14. Method of coating a substrate surface according to claim 1, **characterised in that** it further comprises the step of adding a dispersing agent to the powder material, e.g. selected from the group comprising water, carbonated water, alcohols, oils, acetone, other hydrocarbons, buffer solutions, phosphate solutions and plasticizers.

15. Method of coating a substrate surface according to claim 1, **characterised in that** the step of curing comprises using a curing agent in the form of a liquid or a gas.

16. Method of coating a substrate surface according to claim 1, **characterised in that** the curing agent is a water solution or water vapour.

17. Method of coating a substrate surface according to claim 1, **charact rised in that** the step of hardening the ceramic coating

comprises addition of a component which accelerates or retards the hardening process.

18. Method of coating a substrate surface according to claim 1, **characterised in that** the step of hardening comprises controlling the temperature to be in the range of 0°C to 100°C, preferably in the range 20°C to 70°C.

19. Method of coating a substrate surface according to claim 1, **characterised in that** the deposited coating has a thickness in the order of 0.1-500 µm, and preferably less than 50 µm.

20. Method of coating a substrate surface according to claim 1, **characterised in that** the non-hydrated hydraulic ceramic powder is essentially calcium aluminate, calcium silicate or calcium sulphate or mixtures thereof.

21. Method of coating a substrate surface according to claim 1, **characterised in that** the substrate is Ti or alloys thereof, stainless steel, Co-Cr alloys, another biocompatible metal, polymeric or ceramic material, or any combination thereof.

22. Biocompatible coating, **characterised in that** the coating comprises,

a binding layer in contact with the substrate comprising mainly hydrated calcium aluminate particles of less than 2 µm,

a bulk layer comprising mainly hydrated calcium aluminate having a grain size between 3 and 30 µm, and

an outer layer comprising a bioactive or biocompatible material, preferably calcium phosphate, apatite, calcium carbonate or

calcium fluoride.

23. Biocompatible coating according to claim 22, **characterised in that** the coating is capable of carrying drugs.

24. Surface coated device, comprising a substrate and a surface coating covering at least a section of the substrate surface, **characterised in that** the surface coating is a biocompatible surface coating made by using the method comprising the steps of:

-preparing one powder mixture, or several powder mixtures having different chemical composition, wherein at least one of said powder mixtures comprise a non-hydrated hydraulic ceramic powder binder phase,

-pre-treating the surface of a substrate to increase the adhesion between the substrate and the ceramic coating,

-applying one or more layers of said non-hydrated powder mixtures on top of each other on the substrate, and

-hydrating the powder layer/layers utilizing a curing agent comprising ions of carbonates, phosphates or fluorides.

25. Surface coated device according to claim 24, **characterised in that** the substrate is Ti or alloys thereof, stainless steel, Co-Cr alloys, another biocompatible metal, polymeric or ceramic material, or any combination thereof.

26. Surface coated device according to claim 24, **characterised in that** it is a medical device, medical device for implantation, artificial orthopedic device, spinal implant, joint implant, attachment element, bone nail, bone screw, or a bone reinforcement plate.

27. Surface coated device according to claim 24, **characterised in that** the surface coating is a biocompatible surface coating comprising:

a binding layer in contact with the substrate comprising mainly hydrated calcium aluminate particles of less than 2 µm,

a bulk layer comprising mainly hydrated calcium aluminate having a grain size between 3 and 30 µm, and

an outer layer comprising a bioactive or biocompatible material, preferably calcium phosphate, apatite, calcium carbonate or calcium fluoride.